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that the zoöspores produced by these cells are homologous with the moss spores was not rational; for that zoöspore production is only one method of germination of these cells, depending upon accidental conditions, is proved by the fact that they may grow out directly into filaments, as shown by Chodat and others.

The other new chapter furnishes a convenient but necessarily brief and incomplete *résumé* of the fossil Archegoniates. In the concluding chapter, the author holds mainly the same views as previously: he is inclined to believe that the Spermatophyta are polyphyletic in origin, since the Conifers show the greatest resemblance to the Lycopodiaceæ, and the Cycads to eusporangiate ferns (through the Cycadofilices); while the Monocotyledons may possibly be derived from aquatic ancestors resembling Isoetes, and the Dicotyledons from the Monocotyledon stock.

There are numerous paragraphs in the first edition where the language is obscure, and we have hoped in vain that these might be made more clear for the benefit of the student who can ill spare time to dig out their meaning. Nevertheless in spite of these and some other defects which might have been remedied without very great labor, it must be said that Professor Campbell has given us a much improved and more usable edition of a valuable book.

T. E. HAZEN

**Common and Conspicuous Lichens of New England**<sup>1</sup> is the title of a series of booklets by R. H. and M. A. Howe. The descriptions are accompanied by some very good photographic reproductions of the lichens in their habitats, as well as by line drawings of the thallus. The work is being issued in parts. Part I contains twenty-two pages; Part II, eighteen pages. The following genera are described in the first two parts — Ramalina, Cetraria, Evernia, Usnea, and Alectoria.

H. S. R.

**Czapek's Biochemistry of Plants.**<sup>2</sup> — Each year witnesses an increasing interest in the study of biological chemistry. As time goes on the work becomes broader and yields more results. Until recently the subject would have perhaps been more aptly designated as zoö-

<sup>1</sup> Howe, R. H., Jr., and M. A. *Common and Conspicuous Lichens of New England; a Fieldbook for Beginners.* Boston, W. B. Clarke and Co., 1906. 16mo, Parts 1, 2, 40 pp. \$1.00

<sup>2</sup> Czapek, F. *Biochemie der Pflanzen.* Jena, Bd. 1, 8vo, pp. xv+584, 1904; Bd. 2, 8vo, pp. 1186, 1905.

chemistry, since most of the investigators busied themselves with the physiological chemistry of animals. Indeed, the term *physiological chemistry* itself is usually understood to deal with the study of animal tissues. Happily, this field which has yielded so richly to the zoölogists, is beginning to be explored more widely by the botanists.

The appearance of Czapek's work marks the beginning of an epoch which should mean much for future work in plant physiology and, indeed, in all other lines which are in any way concerned with the chemistry or physiology of the plant. The author is a well trained botanist, physiologist, and chemist. He gives the reader a truly broad and modern view of the subject in hand, the book being in all senses of the word a *biological* chemistry of plants, not a chemistry of plant organs or plant products. Throughout the entire work, we find the literature on every subject summarized and brought down to date with almost unparalleled accuracy and completeness.

The first volume opens with a brief but comprehensive historical introduction. The General Part treats in a very fundamental manner the physical and chemical processes underlying all vital phenomena. Especial attention is given to the characteristics of colloids, to the general chemistry of enzymes, and to the nature of chemical action in the same.

The Special Part opens with a chapter on the fats and lecithins. Their distribution, metabolism, and storage in plants are made topics of especial interest. In discussing the *rôle* of lecithins, the author shows reluctance in accepting any of the theories which assign to them special *rôles*.

The chemistry and occurrence of the sugars is the subject of a very complete discussion occupying some forty pages. This discussion opens the way for the author's extended treatment of carbohydrate metabolism in the plant. He first treats of the storage of carbohydrates and food value in fungi, bacteria (including alcoholic and other fermentations), seeds, and subterranean storage organs. Then he discusses with great fullness the carbon assimilation of the green organs of plants. Naturally, his treatment is too extensive to be set forth adequately in a review paragraph. Suffice it to say that the author brings together the results of the best work on that subject and discusses it fully from the standpoint of chemistry and biology. The carbohydrates are treated from their origin in the plant to their storage as reserve products in various storage organs.

Following the above subject in quite a logical manner comes the study of the cell wall of the plant. First comes the unmodified cellu-

lose wall of simple plants or plant organs, then the hemicelluloses, pectins, and pentosans, and finally the chemical and physical changes which walls undergo. With these considerations the first volume closes.

The second volume continues the treatment of chemosynthetic activity. More than two hundred pages are devoted to the proteids. Our knowledge of the general chemistry of vegetable proteids and of proteolytic ferments is comprehensively written up and revised to the end of the year 1904. The proteid metabolism of the bacteria, fungi, ripe seeds, seedlings, etc., is given separate treatment. In successive chapters the discussion takes up the proteid bodies, their cleavage by ferments, absorption of the products by the plant, and formation of reserve proteids.

One is gratified to find that the author sets forth at some length the elucidating theory of proteid chemistry based upon the amino-acid constitution. Since this new theory promises to clear up the "mysterious" structure of the "awful proteid," it is proper that it receive a prominent place in any comprehensive work on biochemistry.

The pyridin and chinolin bases are given very full treatment in the discussion of alkaloids.

The phenomena of respiration, fermentation, and oxidizing enzymes are made the principal topics of a long and interesting chapter on the absorption of oxygen by plants. Here, as elsewhere, the author brings out with force and clearness the chemical basis of the activities of living matter. Naturally, the oxidation of carbohydrates and the distribution and constitution of the resulting vegetable acids receive extended treatment at this place. The author is inclined to support the view of Neubauer, that the vegetable acids have the function of neutralizing the inorganic bases which are formed in ripening fruits. The great mass of literature on oxidizing enzymes is carefully brought together and arranged in an orderly manner. The author points out that in many studies of oxidases sufficient care has not been used to exclude other enzymes.

The discussion of "omnicellular cyclic carbon compounds" is largely devoted to quinone, phenols, and tannin. Czapek contends that the concept of "tannin," as used in botany, is altogether too loose, this name being applied to any substance which turns black upon the addition of iron chloride, but many substances like vanillin and morphine react with iron like tannin. He probably sets forth the true estimate of tannin when he shows that it does not perform any one but a variety of functions in the plant.

One hundred and seventy pages are devoted to the *rôle* of the mineral elements in plants. It is probably safe to say that never before has this subject been so scientifically treated, nor has such a wide range of analyses been collected into one work. In no other part of the work does the author show greater breadth of mind and freedom from provincial ideas than in dealing with this oft-debated subject. The discussion treats in separate chapters the *rôle* of the elements in bacteria and fungi, in seeds, in subterranean storage organs, in buds, in the wood of trees, in the bark of trees, in leafy organs (including mosses and ferns), in algæ, in pollen grains, in fruits, and in roots. Not merely are many tables of analyses given, but there is discussion upon the probable value and function of each element to the plant. Much discussion is given to the probable *rôle* of elements like calcium and magnesium, on which much work has been done. In the particular case of these elements, the author brings together the results of a large number of workers with great justice and precision. The work of Loew is naturally given much prominence, yet he thinks that that author has not in all cases taken a sufficiently broad view of the facts, since too great importance is undoubtedly attached to the antagonism of calcium and magnesium.

The last chapter of the book is devoted to a discussion of the responses of plants to chemical stimuli. Under different headings there is brought together the work on the stimulation of protoplasmic streaming; the stimulation of nuclear and cell division; the stimulation of growth by toxic substances; the formative effect of chemical stimuli upon vegetative and reproductive organs.

The book is indispensable to all workers in physiology, whether of plants or animals, as well as in physiological and organic chemistry.

H. S. R.

**Lacouture's Liverworts of France.**<sup>1</sup> — This elaborate monograph takes the form of a synoptical key which is arranged in three series of tables; the first gives the characters of the tribes, the second of the genera, and the third of the species. Seventy-five genera containing two hundred and twenty-five species are described.

The characters upon which the classification rests are almost entirely those of the vegetative structures, and they are minutely depicted.

<sup>1</sup> Lacouture, Ch. *Hépatiques de la France. Tableaux synoptiques des caractères saillants des tribus, des genres et des espèces.* Paris, P. Klincksieck., 1905. 4 to 77 pp., 200 figures.